



Technical Review Site Inspection Report

Regional Groundwater Contamination
(Alleged St. Louis Park Solvent Plume)
St. Louis Park, Minnesota

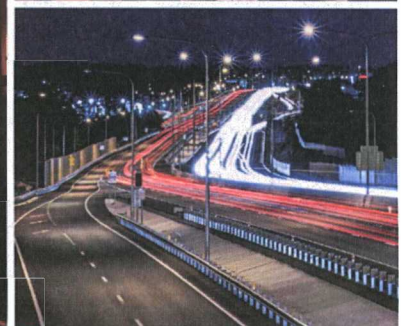
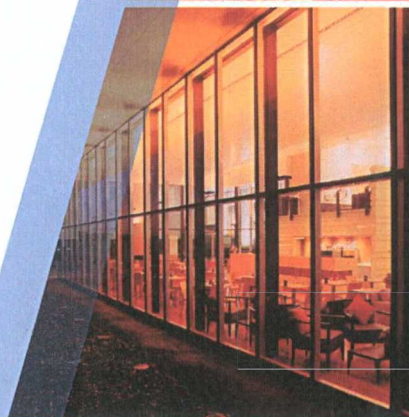
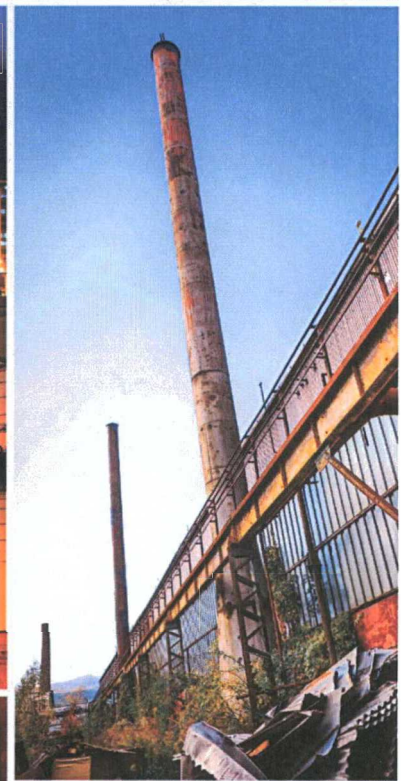
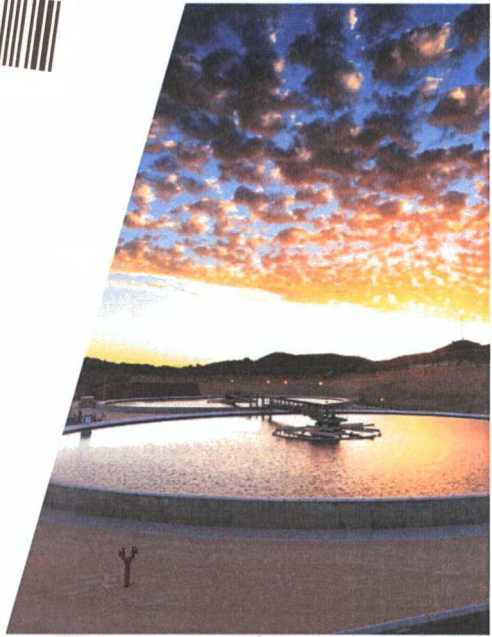




Table of Contents

1.	Introduction.....	1
2.	Potential Sources Contributing CVOC to the Regional Groundwater Contamination.....	3
3.	The Presence of CVOCs in Upgradient Deep Aquifer Wells	5
4.	The Presence of CVOCs at the Reilly Tar Groundwater Treatment Plant.....	5
5.	Conclusions.....	6

Figure Index

Figure 1	Area Site Plan
Figure 2	Potential CVOC Contaminant Sources Near Well W437

Appendix Index

Appendix A	Potential Industrial Sources that Used Solvents
Appendix B	Location of Investigated Sites Near W437 (AECOM, 2006)
Appendix C	Hydraulic Capture Analysis Near Former Reilly Tar Superfund Site



1. Introduction

On behalf of Daikin Applied Americas Inc. (Daikin) and Super Radiator Coils, LP (SRCLP), this report provides a technical review and critique of the Minnesota Pollution Control Agency (MPCA) Site Inspection Report (SIR), dated February 17, 2017¹. The SIR provides additional information concerning regional groundwater contamination, which the MPCA has incorrectly described and alleges to be the "St. Louis Park (SLP) Solvent Plume". The MPCA prepared and submitted its SIR to the United States Environmental Protection Agency (EPA) as part of a Cooperative Agreement between the MPCA and EPA under the authority of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). The SIR succeeds the MPCA's Preliminary Assessment Report (PAR) that was prepared and submitted to the EPA on December 17, 2015. GHD assessed the PAR and prepared a Technical Review Report that was submitted to the MPCA and EPA on May 24, 2017². GHD incorporates the questions and observations included in that Technical Review Report by reference here, unless expressly altered herein.

Essentially, the SIR provides supplemental information to the PAR. This supplemental information includes groundwater sampling results from selected monitoring and municipal wells in St. Louis Park and Edina, Minnesota. The SIR also examines exposure pathways for groundwater, surface water, soil, and air.

However, similar to the PAR, the SIR fails to provide important information scientifically necessary to support its conclusions about the existence and sources of the alleged Plume. Specifically,

- The SIR presents a confusing and misleading representation of the "site" boundaries and the "source" location, and the proximity of the "site" and "source" to the affected municipal wells. The document does not even provide simple maps showing the direction of groundwater flow in relevant aquifers that would help explain any shape or size of the alleged "Plume". It fails to account for documented historic findings that are contrary to the PAR's assertion of groundwater flow from the asserted "main source area" of Highway 7 and Wooddale Ave to the Edina or St. Louis Park drinking water intake wells.
- The SIR purports to characterize the area wide groundwater contamination in the deep Prairie du Chien aquifer as a plume having originated from a "source" near Highway 7 and Wooddale Avenue that then migrated approximately two miles to the south, despite the fact that the natural direction of groundwater flow in the Prairie du Chien aquifer in the area of St. Louis Park is from the west to the east or slightly south of east³.
- The SIR lacks a conceptual site model that demonstrates, with measured data, the asserted migration pathway of contamination from the Highway 7/Wooddale Ave "source" to the municipal wells up to 2.5 miles to the south that the SIR alleges were affected by the "source". A site model should include the velocity, direction of groundwater flow, and contaminant concentration in each relevant aquifer including the uppermost drift aquifer near the surface, the Platteville, the Glenwood shale, the St. Peter Sandstone, and the Prairie du Chien.

¹ Daikin and SRCLP received the SIR from Minnesota Pollution Control Agency on September 6, 2017

² Daikin and SRCLP received the PAR from Minnesota Pollution Control Agency on August 10, 2016

³ USGS, 1984. Preliminary Evaluation of Ground-water Contamination by Coal-Tar Derivatives, Figures 9 and 10.



- The SIR defines “background” wells W27 and W426 in the Platteville formation for the 6714 Walker Street area without demonstrating the direction of groundwater flow in this aquifer. Accordingly, the SIR fails to describe potentially related contamination in the Platteville aquifer to the southwest in wells W421 and W18 (the locations of the highest reported vinyl chloride concentrations areawide).
- The SIR fails to account for significant known sources of chlorinated solvents to groundwater, such as Lindberg Heat Treating Facility investigated by Rust Environment & Infrastructure (1994.⁴), which reported significant TCE concentrations (between 5,000 and 50,000 micrograms per liter [µg/L]) and reported by STS Consultants, Ltd. (STS) in 2005.⁵ Other known significant sources of chlorinated ethenes and ethanes which could have contributed to vinyl chloride and 1,4-dioxane contamination in SLP4, SLP6, and possibly Edina wells such as Schloff Chemical and Control Data Corporation. These sources are not discussed in the SIR. STS investigations also identified dozens of other industrial facilities, which used and may have released chlorinated solvents but were similarly ignored in the SIR.
- The SIR fails to deal with indications from the data (STS, 2005.⁶) of the significance of multi-aquifer wells, which provide vertical conduits between aquifers such as W-23 and W-105 on the Reilly Tar site (see Figure 1), and others.
- The SIR fails to recognize the presence of other compounds of concern, such as 1,4-dioxane. 1,4-dioxane is of particular importance as its presence above MCLs requires specialized treatment (advanced oxidation process), which is separate from, and more expensive than, common treatment for vinyl chloride. 1,4-dioxane is unrelated to the degreasing chemical tetrachloroethene (PCE) and its degradation products. It is frequently associated with 1,1,1-trichloroethane (TCA). The presence of 1,4-dioxane in the municipal wells also is significant because it has never been reported in the immediate Walker and Lake Street area where the former Super Radiator site (6714 Walker Street) is located, suggesting one or more significant sources that have yet to be identified or adequately investigated.
- The SIR fails to rigorously or even anecdotally support the concept that there is a true “plume” rather than areawide historic contamination of groundwater from numerous multiple VOC spills, leaks, and releases from a variety of urban sources known to have used CVOC materials.

In this report, GHD provides further information that should be considered when evaluating the regional contamination that is allegedly the St. Louis Park Solvent Plume and the MPCA's statements and conclusions in the SIR about the so-called plume and its alleged sources:

- The location and identification of other potential chlorinated volatile organic compounds (CVOCs), such as PCE, TCE, or TCA, that could be contributing to regional groundwater contamination

⁴ RUST Environment & Infrastructure. 1994. Trichloroethylene Release Remedial Investigation and Corrective Action- Lindberg Heat Treating Facility 6981 Oxford Street, April 1994

⁵ STS Consultants Ltd. 2005. Land Use and Source Characterization Survey- Edina Well Evaluation, 416 pgs, dated June 7 2005

⁶ STS Consultants, Ltd. 2005. City of Edina Well No. 7 Study – Phase II report March 2005 to June 2005, 230 pgs., dated June 30, 2005



- Information on the presence of CVOCs in wells screened in the regional municipal aquifer and located hydraulically upgradient from the 6714 Walker Street property
- Information on the CVOCs found in the Reilly Tar Superfund site groundwater remediation system and that system's potential effect on groundwater flow patterns in the shallow glacial drift and Platteville Limestone aquifers

2. Potential Sources Contributing CVOC to the Regional Groundwater Contamination

The St. Louis Park area has been the subject of numerous investigations to identify potential sources of CVOC groundwater contamination. In 2005 and 2006, STS conducted an area wide source investigation for the MPCA⁷. The 2005 investigations focused on the groundwater contamination potentially associated with Edina Well No. 7 (ED-7). Specifically, the STS investigation (Ref. 5) identified numerous manufacturing facilities including machine shops, tool and die makers, engine rebuilders, and metal fabricators located in St. Louis Park within an approximate one square mile area. STS reviewed city directories between 1956 and 1988 and listed 86 businesses that may have used solvents. A copy of those business listings is provided in Appendix A. The 2005 investigation also noted the reported disposal of liquid waste at the former Golden Auto Parts Site at 7003 West Lake St (across Highway 7 and southwest of W437)⁸. Despite the highest concentrations of vinyl chloride having been reported in Platteville wells W18 and W421 and a reported natural direction of groundwater flow in this unit to the northeast⁹, this aquifer was not fully investigated.

In 2005, STS (Ref. 6) performed a Phase II report related to the City of Edina Well No. 7 (ED-7) study. The study looked at potential contributing contaminant sources to ED-7 and included sampling of existing Reilly Tar monitoring wells from the four major groundwater systems – glacial drift, Platteville Limestone, St. Peter Sandstone and Prairie du Chien Group. The groundwater sampling by STS found elevated CVOCs in certain glacial drift and Platteville wells (e.g., W437) in the St. Louis Park area. The 2005 STS reports (Refs. 5 and 6) drew the following conclusions:

- Several commercial and industrial sites (including Thermotech and Hopkins Landfill) exist upgradient of ED-7 and contain CVOCs in shallow groundwater. The natural direction of groundwater flow in the Prairie du Chien aquifer is to the southeast, therefore one must look to the northwest for potential sources of contamination to ED-7. In addition, some of these upgradient sites are located near a deep bedrock valley that reportedly provides a direct hydraulic connection (i.e., no hydraulic barriers) from the drift aquifer to the Prairie du Chien-Jordan (PdCJ) municipal aquifer.
- The calibrated Reilly Tar Site Groundwater Model could not “simulate groundwater flow from the southern portion of St. Louis Park to the ED-7 well.”

⁷ STS Consultants, Ltd. 2006. St. Louis Park W437 Chlorinated Source Investigation, 57 pgs., dated March 13, 2006.

⁸ STS Consultants, Ltd.. 2005. Land Use and Source Characterization Survey – Edina Well Field, dated June 2005.

⁹ ERT, a Resource Engineering Co., 1987, Drift-Platteville Aquifer Northern Area Remedial Investigation Plan for Reilly Tar & Chemical Corporation, as amended October 1987, pp. 24-26.



- The lack of contamination found in the St. Peter Sandstone aquifer, which is found between the overlying Platteville and underlying PdCJ aquifer, "puts to question a conceptual model that postulates that the St. Louis Park source area contaminants migrate mainly from the Platteville aquifer through the intermediate St. Peter aquifer to the deeper PdCJ aquifer system."

These conclusions negate the assertions in the PAR and SIR as to the main source area of the alleged Plume.

The MPCA thereafter authorized the STS 2006 investigation in the Walker Street and Lake Street area of potential CVOC sources near W437. Inexplicably, the 2006 investigation did not include the Reilly Tar site, which had reported CVOCs in its onsite well (W23) dating back to 2004. In 2006, STS reviewed the Hennepin County Hazardous Waste Generators for records of waste generation dating back to the 1980s. From this database review, STS identified 82 sites and listed 49 sites in the area of W437 that used or appeared to have used CVOCs. Figure 2 shows the locations of these 49 sites. Under this investigation, STS collected no physical data (e.g., soil samples) from these sites to determine if they were a CVOC source.

In 2009, AECOM¹⁰ investigated 12 sites in the 6714 Walker Street area for the MPCA. The 12 locations are shown in Appendix B. The investigation involved soil, soil gas, and groundwater sampling at selected areas. The 2009 investigation found contamination at all 12 sites and ranked Eclipse Electric and Bryant Graphics as prime sources for PCE contamination. The 2009 report also mentions a CVOC source upgradient (west) of Pampered Pooch (7020 Walker St.) and Family Digest (7008 Walker St.). Samples collected at MinValco (3340 Gorham Ave.) had high concentrations of naphthalene, which is very likely related to the Reilly Tar Superfund Site.

Despite these data and information, the MPCA once again did not include the Reilly Tar Superfund site in these investigations, even though CVOCs were found in deep Reilly Tar wells (e.g., W-23) beginning in 2004 (AECOM 2013).¹¹

In 2014, USEPA contracted a soil gas survey in the former Reilly Tar area. The soil gas survey detected both PCE and TCE in sub slab samples. These data are documented in a CH2MHill Technical Memorandum to the USEPA entitled: *Vapor Intrusion Pathway Investigation Report Reilly Tar and Chemical Corporation Superfund Site St. Louis Park, Minnesota*, dated February 5, 2014. The presence of CVOCs in the sub-slab soil gas, even at low concentrations, indicates residual CVOC contamination exists in the former Reilly Tar area that has never been investigated.

The failure of both the PAR and the SIR to investigate and consider Reilly Tar as a potential CVOC source for the St. Louis Park Plume means both reports lack sufficient scientific or technical rigor to constitute credible investigation or site summaries. No investigation of the regional contamination that the MPCA asserts is a "plume" can be considered complete without a full investigation of the role the Reilly Tar site may be playing in the past, present, and future state of the alleged Plume.

There is no documented reason to identify the area of Walker and Lake Streets as the main source area for the alleged Plume or existing regional groundwater contamination, given the multiple

¹⁰ AECOM. 2009 Twelve Sites in St. Louis Park, Potential Sources of Chlorinated VOCs Investigation, St. Louis Park, Minnesota. 1,068 pgs., dated June 30, 2009.

¹¹ AECOM. 2013. VOC Sampling of the Edina and St. Louis Park Wells in FY2013. June 2013.



findings of CVOCs being released in other places upgradient and crossgradient, within and outside of the alleged plume boundary and upgradient from Edina Well No. 7. (Refs. 5 and 6).

3. The Presence of CVOCs in Upgradient Deep Aquifer Wells

CVOCs are present in deep aquifer wells located more than one-quarter mile upgradient of 6714 Walker Street. Figure 1 identifies these deep impacted wells. Two wells located on the former Reilly Tar property (W-23 and W-105) have repeatedly tested positive for CVOCs in their groundwater samples. As reported in Section 3.2.1 of our March 2017 Technical Assessment Report on the PAR, W-23 and W-105 cross connect multiple aquifers, including the aquifers used by the SLP and Edina municipal wells. These Reilly Tar wells are likely conduits for cross contamination flow between the different aquifers and direct conduits to the regional Prairie du Chien/Jordan municipal aquifer system.

The SIR included sampling results of several municipal wells in SLP and Edina. SLP5 was sampled as a "background" municipal well. (see Figure 1). SLP5 is located one mile WNW of 6714 Walker Street and is an inactive (non-pumping) municipal well. SLP5 is screened in the Prairie du Chien-Jordan aquifer. The SLP5 sample contained two CVOCs, *cis-* and *trans*-1,2-dichloroethene. The presence of CVOCs at this inactive well indicates that CVOC sources that have no possible connection to past operations at 6714 Walker are present in the aquifers used by municipalities throughout a large regional area. The SIR, like the PAR before it, however, ignores this key piece of information. This failure constitutes another deficiency that demonstrates the lack of evidential support for MPCA's allegations and conclusions that the alleged St. Louis Park Solvent Plume exists or is sourced as MPCA alleges.

4. The Presence of CVOCs at the Reilly Tar Groundwater Treatment Plant

The Reilly Tar groundwater treatment plant is located south of Highway 7 and east of Louisiana Boulevard, approximately 1,000 feet WSW of 6714 Walker Street. Figure 1 shows the location of the treatment plant. Two nearby wells, W420 and W421, were installed in the late 1980s as source control wells to contain contamination emanating from the Reilly Tar site. W420 and W421 pump from the glacial drift and underlying Platteville Limestone, respectively.

As noted in Section 3.3 of GHD's Technical Assessment report, both pumping wells capture CVOCs. Given their proximity (hydraulically upgradient) and distance (> 1,000 feet) from 6714 Walker St., these wells are very unlikely to capture groundwater from 6714 Walker St. By applying standard analytical analyses (EPA, 2008.¹²) and published hydraulic values for this area (Lindgren, 1995).¹³, the maximum capture width developed for each well should range between 200 and 800 feet.

¹² Environmental Protection Agency. 2008. A Systematic Approach for Evaluation of Capture Zones at Pump and Treat Systems. EPA600/R-08/003. 166 pgs.

¹³ Lindgren, R. J. 1995. Hydrogeology and Ground-Water Flow of the Drift and Platteville Aquifer System, St. Louis Park, Minnesota. U. S. Geol. Survey, Water-Resources Investigations Report 94-4204, 84 pgs.



Therefore, the Reilly Tar source control pumping wells do not capture CVOC groundwater from 6714 Walker Street, but rather capture CVOCs from an upgradient source close to Reilly Tar. Hydraulic capture zone analysis is presented in Appendix C.

5. Conclusions

Similar to the PAR, the SIR ignores potential contribution from many known and potential sources of CVOCs to groundwater. The SIR fails to recognize the wide-spread presence of CVOCs in the regional aquifer system, including in designated "background wells" (e.g., SLP5). The SIR also fails to recognize the presence of 1,4-dioxane in municipal wells, which is unrelated to the degreasing chemical PCE that has not been detected in the alleged "main source area," and will require separate and expensive treatment.

The SIR does not establish a contaminant pathway between the alleged "main source area" to the deeper Prairie du Chien/Jordan aquifer and the municipal wells to the south. It does not actually document or trace how VOCs from the alleged main source area at Walker Street reach any bedrock valley or turn to the south towards Edina. The SIR overlooks multi-aquifer wells that provide a direct conduit to the Prairie du Chien/Jordan aquifer, specifically Reilly Tar wells W-23 and W-105 (see Figure 1) that have repeatedly shown CVOCs.

Based on these discrepancies as well as the ones described in GHD's March 2017 Technical Assessment Report, both the December 2015 PAR and the February 2017 SIR should be withdrawn. Both are fundamentally deficient because they overlook or omit key data and information, which refutes many of the conclusions contained in the reports.

FIGURES



Source: Hennepin County

LEGEND

- 6714 WALKER STREET SITE
- PRAIRIE DU CHIEN-JORDAN WELL
- REILLY TAR MULTI-AQUIFER WELL
- GLACIAL DRIFT WELL
- PLATTEVILLE LIMESTONE WELL



ST. LOUIS PARK SOLVENT PLUME
ST. LOUIS PARK, MINNESOTA
SITE INSPECTION REPORT FOLLOW-UP INFORMATION

AREA SITE PLAN

088751-00
Nov 3, 2017

FIGURE 1



Source: Hennepin County

0 200 400 600 ft



LEGEND

- 01 POTENTIAL CVOC SOURCE
- ★ 6714 WALKER STREET SITE
- W WELL W437



ST. LOUIS PARK SOLVENT PLUME
ST. LOUIS PARK, MINNESOTA
SITE INSPECTION REPORT FOLLOW-UP INFORMATION
POTENTIAL CVOC CONTAMINANT
SOURCES NEAR WELL W437

088751-00
Nov 3, 2017

FIGURE 2

Appendix A

Potential Industrial Sources that Used Solvents

Edina Well Evaluation
STS Project 99613-XB
May 27, 2005

Table 1
City Directory Review by Year
Businesses which may have used solvents

1956

Address	Business Name	Business Type
3601 Alabama Ave. S.	Federal Tool Mfg. Co.	tool manufacturer
6325 Cambridge St.	Magnetic Controls Co.	electronic equipment
6401 Cambridge St.	Hedquist & Nelson	metal fabricators
5925 Highway 7	Century Products Co.	machinists
3412 Louisiana Ave.	Park Cleaners	dry cleaners
3305 Republic Ave.	Lakeshore Mfg. Co.	agricultural implement mfr.
3333 Republic Ave.	Precisions Motor Rebuilders	auto repair
6518 Walker St.	Ringerud Equipment Co.	tool mfrs.

1961

Address	Business Name	Business Type
5806 - 36th St. W.	Cedar Eng. Div. of Control Data Corp.	mfr.
6327 Cambridge Ave.	Gopher Motor Rebuilding	engine repair
6418 Cambridge Ave.	Mid-City Precision Inc.	machinists
6521 Cambridge Ave.	Hamer Machine Co.	--
3358 Gorham Ave.	Malco Products	metal goods mfr.
6015 Highway 7	Park-Hy Auto Service	auto repair
6201 Highway 7	Johnson's Auto Service	auto repair
3412 Louisiana Ave.	Park Cleaners	dry cleaners
3351-55 Republic Ave.	Reuter Inc.	machinists

1966

Address	Business Name	Business Type
5806 - 36th Ave.	Control Data	
3391 Brownlow Ave.	Thalmo Corp.	tool & die mfr.
6327 Cambridge St.	Gopher Motor Rebuilding Inc. (plant)	
6401 Cambridge St.	Gopher Motor Rebuilding Inc.	
6405 Cambridge St.	ADC Products	electronic equipment
	Magnetic Controls Co.	--
6418 Cambridge St.	Mid City Precision Inc.	machine shop
6521 Cambridge St.	Hamer Machine Co.	
	Model Research Inc.	electronic research
6425 Goodrich Ave.	Lyons Mfg. Inc.	machine shop
3304 Gorham Ave.	Richlind Metal Fabricators	
3320 Gorham Ave.	Micko Tool & Engineering	machinists
3356 Gorham Ave.	Credo Tool & Die Co.	mfrs.
5925 Highway 7	Dayton Rogers Mfg. Co. (plant)	hydraulic equipment mfrs.
6800 Lake Street	Aremco Inc.	machinists
3333 Republic Ave.	Fors Metal Specialties, Inc.	--
3565 Wooddale Ave.	Thiele Engineering Co.	packaging machine mfrs.

Edina Well Evaluation
 STS Project 99613-XB
 May 27, 2005

1982

Address	Business Name	Business Type
6315 Cambridge Ave.	Electro Die Assoc. Inc.	tool & die shop
6318 Cambridge Ave.	Universal Circuits	--
6324 Cambridge Ave.	Universal Circuits	printed circuits
6327 Cambridge Ave.	Gopher Motor Rebuilding Inc. (plant)	
6519 Cambridge Ave.	Hamer Machine Co.	
6521 Cambridge Ave.	Esko Wine Co. Hamer Machine Co.	machine shop
3836 Edgewood Ave.	Altmann Machine	storage
3838 Edgewood Ave.	Altmann Machine	tool & die
3338 Gorham Ave.	Aljon Tool	mfrs.
3404 LeCraig Lane	Aremco Inc.	gear cutters & precision machine
6751 Oxford St.	Lowell Inc.	machine shop
7009 Oxford St.	Ver-Sa-Til Assoc. Inc.	machine shop

1988

Address	Business Name	Business Type
6327 Cambridge Ave.	Gopher Motor Rebuilding (plant)	
6401 Cambridge Ave.	Gopher Motor Rebuilding (plant)	
6521 Cambridge Ave.	Hamer Machine Co.	
3838 Edgewood Ave.	Altmann Machine	tool & die
3318 Gorham Ave.	Medina Precision	machine shop
5925 Highway 7	Dayton Rogers Machine Products	machine parts mfr.
6416 Highway 7	Professional Instruments Co.	machine shop
3404 Library Lane	Arenco Inc.	precision machinery
6831 Oxford St.	Control Data	
6853 Oxford St.	Ultramatic Inc.	mfg. job shop
7009 Oxford St.	Ver-Sa-Til Assoc. Inc.	machine shop
3305 Republic Ave.	Hoff Machining	--
3313 Republic Ave.	Twin City Machine Tool Rebuilding	--

The listings show an increase in the number of businesses possibly using solvents from 1956 through 1977, consistent with the increase in commercial buildings observed in the aerial photographs. The 1982 and 1988 city directory listings showed fewer businesses which possibly used solvents in the study area. It should be noted that sanitary sewer and water service was apparently extended into the area in the mid-1970s. Potential exists that

Edina Well Evaluation
 STS Project 99613-XB
 May 27, 2005

1970/71

Address	Business Name	Business Type
3391 Brownlow Ave.	Thalmo Corp.	tool & die mfr.
6323 Cambridge Ave.	Superb Associates Precision Machine Parts	--
6327 Cambridge Ave.	Gopher Motor Rebuilding Inc. (plant)	
6521 Cambridge Ave.	Hamer Machine Co.	--
3830 Edgewood Ave.	Proto-Type Inc. Western Tool & Die	tool & die mfrs.
6425 Goodrich Ave.	Daufelt Industries Inc.	platers
3304 Gorham Ave.	Raleigh Industries Inc.	machinists
3320 Gorham Ave.	Micro Tool & Engineering	machinists
6800 Lake Ave.	Microtech Inc.	machinists
3406 Louisiana Ave.	Miko Machine Tool	machinists
3333 Republic Ave.	Fors Metal Specialties Inc.	--
7013 Walker St.	Lowell Inc.	machine shop

1977

Address	Business Name	Business Type
6315 Cambridge Ave.	Electro Die Inc.	tool & die shop
6324 Cambridge Ave.	Spectra-Strip of Minneapolis	printed circuits
6327 Cambridge Ave.	Gopher Motor Rebuilding Inc. (plant)	--
6416 Cambridge Ave.	Mag-Tech Inc.	electronic equipment mfr.
6416-1/2 Cambridge Ave.	Tru-It Mfg.	machine shop
6519 Cambridge Ave.	Hamer Machine Co.	--
6521 Cambridge Ave.	Hamer Machine Co. Esko Wire Co.	-- machine shop
3838 Edgewood Ave.	Altmann Machine	tool & die machinists
3840 Edgewood Ave.	Norskil Tool & Mfg. Co.	--
3300 Gorham Ave.	D-L's Die Cutting Inc.	--
3304 Gorham Ave.	Drill A Matic	machine shop
3338 Gorham Ave.	Aljon Tool Inc.	mfrs.
5925 Highway 7	Dayton Rogers Mfg. Co.	hydraulic equipment
3404 Louisiana Ave.	Arenco Inc.	machine shop
6751 Oxford St.	Lowell Inc.	machine shop
7005 Oxford St.	RL Tool	machinists
7009 Oxford St.	Ver-Sa-Til Assoc. Inc.	machine shop





Drawn:	GJR	05/12/2005
Checked:	GJR	05/12/2005
Approved:	RLD	05/13/2005
PROJECT NUMBER	99613-XB	
FIGURE NUMBER	1	

Appendix B
Location of Investigated Sites Near W437
(AECOM, 2006)

LEGEND

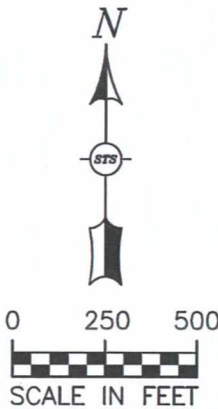
EXTENT OF CHLORINATED
VOC GROUNDWATER PLUME
(AECOM, 2009a)

LOCATION OF INVESTIGATED
SITES

ELEVATED SOIL VOC CONTAMINATION

ELEVATED SOIL GAS VOC CONTAMINATION

ELEVATED GROUNDWATER VOC CONTAMINATION



NOTE: BASE MAP PROVIDED BY [MARKHURD](#) AERIAL PHOTOGRAPH DATED APRIL 04, 2000.

AECOM

161 Cheshire Lane North
Minneapolis, MN 55441
763-852-4220
www.aecom.com
Copyright © 2009, By: AECOM, Inc.

LOCATIONS OF INVESTIGATED SITES
ST. LOUIS PARK, MINNESOTA
FOR: MINNESOTA POLLUTION CONTROL AGENCY

Drawn : CMD 06/10/2009

Checked: PAR 06/10/2009

Approved: RLD 06/15/2009

PROJECT
NUMBER 04660024

FIGURE
NUMBER 1

Appendix C

Hydraulic Capture Analysis Near Former Reilly Tar Superfund Site

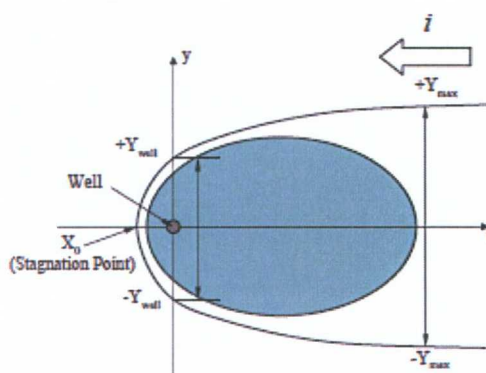
Capture Zone Analysis Reilly Tar Pump and Treat Systems

PARAMETERS	W420	W421
Extraction Rate (Q) [ft ³ /d]	7,700 (40 gpm)	3,850 (20 gpm)
Hydraulic Conductivity (K) [ft/d]	100	300
Hydraulic Gradient (i) [ft/ft]	0.002	0.002
Saturated Thickness (b) [ft]	50	30

Capture Zone Width Calculation, One Extraction Well

Assumptions:

- homogeneous, isotropic, confined aquifer of infinite extent
- uniform aquifer thickness
- fully penetrating extraction well(s)
- uniform regional horizontal hydraulic gradient
- steady-state flow
- negligible vertical gradient
- no net recharge, or net recharge is accounted for in regional hydraulic gradient
- no other sources of water introduced to aquifer due to extraction (e.g., from rivers or leakage from above or below)



$$x = \frac{-y}{\tan\left(\frac{2\pi Ti}{Q} y\right)} \quad - \text{or} - \quad y = \pm \left(\frac{Q}{2Ti} \right) - \left(\frac{Q}{2\pi Ti} \right) \tan^{-1} \left(\frac{y}{x} \right)$$

$$X_0 = -Q / 2\pi Ti \quad ; \quad Y_{\max} = \pm Q / 2Ti \quad ; \quad Y_{\text{well}} = \pm Q / 4Ti$$

(must use consistent units, such as "ft" for distance and "day" for time)

Where:

- Q = extraction rate
- T = transmissivity, $K \cdot b$
- K = hydraulic conductivity
- b = saturated thickness
- i = regional (i.e., pre-remedy-pumping) hydraulic gradient
- X_0 = distance from the well to the downgradient end of the capture zone along the central line of the flow direction
- Y_{\max} = maximum capture zone width from the central line of the plume
- Y_{well} = capture zone width at the location of well from the central line of the plume

(Figure 14; EPA, 2008)

Capture Zone Calculations	W420	W421
Stagnation Point, X_0 [ft]	-123	-34
Maximum Half-Width, Y_{\max} [ft]	385	107
Half-Width at Well Y_{well} [ft]	193	53
Maximum Capture Zone Width [ft]	770	214